Telecommunications Policies: Determinants and Impact[1]

(PRELIMINARY)

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Abstract

This paper presents new data, in the form of four indices, on market-opening policies and the independence of regulators for a cross section of countries. These indices are combined with a comprehensive set of performance, institutional and political data to quantify both the determinants and the impact of telecommunications policies. We find that entry policies are associated with the degree to which countries have an interventionist tradition, but not with the partisan ideology of reforming countries *per se*. We also find that countries where the institutional endowment constrains less the behaviour of the executive bodies, and countries with a stronger incumbent, are more prone to create truly independent regulatory agencies. There is weak evidence that the creation of truly independent regulatory agencies has a positive effect on network penetration, as estimated taking into account the endogeneity of independence.

Keywords: telecommunications, liberalization, institutions.

JEL Classification: L96, L32, F21.

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1.Introduction

The last years of the twentieth century were very rich in reform initiatives in the telecommunications sector. Many countries introduced private ownership of the dominant operators, liberalized at least some segments of the industry and introduced new regulatory authorities. Regulatory reform has, however, many dimensions and takes different forms across countries.

The objective of this study is to analyze and measure the reform processes taking into account such multi-dimensionality, and to quantify both the determinants and effects of reform initiatives. We focus on liberalization policies and the degree of independence of regulatory authorities. We present four new indices, two for liberalization and two for independence, that summarize the information of a large number of variables or indicators relevant to these policy areas.

Although there is a general consensus among scholars and international institutions (such as the World Bank, the OECD, the International Telecommunications Union, the European Commission) that opening up the telecommunications sector to competition is both possible and beneficial for social welfare, some related issues are still controversial. Many of these still controversial issues can be summarized in one question: how much should entrants be favoured *vis-à-vis* incumbents? In other words, how biased or asymmetric should regulation be in the market-opening phase? Although incumbent operators have huge incumbency advantages in most countries, they also carry the burden of funding universal service, they are the main providers of infrastructure, and they produce with scope economies in several segments. There is the potential risk that regulators favour some competitors rather than more competition, allowing the entry of inefficient firms and imposing unnecessary constraints on incumbents.

Something similar happens with the related issue of regulatory independence. Although scholars and international institutions advocate the establishment of independent regulators, there is less discussion and consensus on the particular attributes of independent regulators and on how to make independence sustainable. On this, we can follow the academic literature on central bank independence which analyzes the issue through the creation of appropriate aggregate indices that take into account several

dimensions of independence. We take a first step in this direction for telecom regulators.

Along the lines of the recent empirical literature on political economy,[2] we take into account the potential endogeneity of policies. We do so to evaluate the incidence of policies (entry and regulator independence) on telecommunications performance (network penetration and productivity). Comparative assessment of telecommunications reform is an active area of research.[3] Our contribution to this growing literature is twofold:

-First, we put our original indices to work, so that our policy variables and our estimates reflect the fact that both liberalization and regulatory independence are multi-dimensional phenomena.

-Second, we use a battery of institutional indices that have been used in the rest of the literature[4] only each one at a time. Through this, we are able to assess the relative explanatory power of each of them, and to relate them to the policies and performance in telecommunications.

Among our preliminary results, we find that entry policies are associated with the degree to which countries have an interventionist tradition, but not with the partisan ideology of reforming countries per se. We also find that countries where the institutional endowment[5] constrains less the behaviour of the executive bodies are more prone to create truly independent regulatory agencies. There is weak evidence that the creation of truly independent regulatory agencies has a positive effect on network penetration, as estimated taking into account the endogeneity of independence.

The paper is organized as follows. Section 2 presents the specification strategy, the hypotheses and the relationship with the existing literature. Section 3 presents the data. Section 4 shows and discusses the preliminary results obtained with this data set, and next we briefly present our conclusions.

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[2] See Besley and Case (2000), Roller and Duso (2001), Beck et al. (2001).
[3] See Ros (2002), Wallsten (2001), Fink et al. (2002), Boylaud and Nicoletti (2000), Li et al. (2002).
[4] See LaPorta et al. (1999 and 2002), Kaufmann and Kraay (2002), Henisz and Zelner (2000a and b).
[5] The institutional endowment is the set of formal or informal rules that constrain the behaviour of citizens in society. Examples of elements of the institutional endowment are whether the system is presidential or parliamentary, the degree of proportionality in the electoral rules, the quality and efficiency of the civil service or the judiciary, etc. (see Levy and Spiller, 1996).

2. Specification

Roller and Duso (RD, 2002) claim that previous studies fail to take into account the endogeneity of policies, and suggest the use of political variables (following Besley and Case, 2000) as instruments to achieve consistency in the estimators. Then RD show a preliminary exercise using such variables and find that the results of the previous literature (particularly the OECD studies) are no longer valid. Their model specification is as follows:

(i) $s=f$(Political Institutions, Regulatory Institutions, Ideology, q)$+\varepsilon$

(ii) $q=g$(Demand, Costs, Market Structure, s)$+v$

where s are the policy variables to be explained (mainly, a liberalization index) and q are the industry outcomes. f and g are functions and e and v error terms. However, regulatory institutions, at least in telecommunications, are as endogenous as liberalization policies themselves, and often decided upon at the same time. RD could also be complemented because among the variables that explain the policy choice they do not include interest groups, which happen to be an important determinant of liberalization and regulatory reform in other studies (see Henisz and Zelner, 2000b).
We want to tackle the endogeneity issue using instrumental variables, such as political variables as in RD, but we will use them for both policies (in this case, deregulation policies in telecommunications) and regulatory institutions (in this case, the independence of the telecom regulator). The specification is the following:

(iii)   *s=h(Political Institutions, Interest groups, q…)+u*

(iv)   *q=g*(Demand, Costs, Market Structure, s)$+v$

where s includes both market-opening policies and the characteristics of regulatory institutions. For simplicity we will call this variable "policies" from now on.
The specification of the econometric model to be used has to take into account the special structure of the telecommunications sector. When confronted with the decision to open segments to competition, the entry barriers faced by new operators are a decisive factor that has to be taken into account. .

Faced with these entry barriers, policy makers may use a number of tools.

Some authors have criticized the use of "infant industry" (or *asymmetric deregulation*) arguments to assist the entry of new firms, and argue that by constraining the behaviour of the incumbents, economic efficiency is hampered through insufficient exploitation of scope economies and insufficient production of new goods. Hence the policy variable *s* will include an index of the degree to which telecommunications policies are located in an *asymmetric deregulation* dimension (an index computed through principal components). In equation (iii) we include lagged performance variables to take into account the potential causal link between better industry outcomes and better future policies.

In equation (iv), the original policy variables must be considered as endogenous and we must use instrumental variables to solve the problem of the correlation of the explanatory variable with the error term.

In the equation that explains the outcomes as a function of the policies and institutions it is very important not to omit any regressor that has a simultaneous and independent influence in policies, regulatory institutions and outcomes (for example, institutional indices of political risk, expropriation risk, political constraints, etc.). In econometric terms, one must have a regressor that is correlated with policies, and use as instrumental variable the part of this variable that explains policies (and institutions) and not directly the economic outcomes that one wants to analyze. The unobservables that may affect both policies and outcomes must be controlled for. This is particularly important in equation (iv), since this is a reduced form equation that summarizes the supply and demand equations that determine the market equilibrium.

With this specification strategy in mind, we test a number of hypotheses derived from the literatures on political economy and regulation.

First, policies are typically associated with institutional traditions. Deregulation policies will be more ambitious in countries with a less interventionist tradition (LaPorta et al., 1999 and 2002). Second, many policies have been observed to be partisan, i.e. different political parties, since they represent different constituencies, will implement different policies (Alesina and Rosenthal, 1995). Right wing coalitions/governments, according to this, emphasizing more free markets than redistributive policies, will be more prone to deregulate and create an environment that is favourable to private investment in telecommunications. And third, policies will be influenced by interest groups, which

compete in the political arena to obtain favourable policies (see Peltzman, 1976, and Grossman and Helpman, 2001)

Hypothesis 1)Market-opening policies are negatively associated with the interventionist tradition of each country, and positively related to the weight of interest groups and the partisan ideology of the reforming country.

The explanatory variables for equation (iii) will include a number of institutional indices. These political variables influence the choice of policies (market-opening policies as well as regulatory institutions). This institutional indices will be used also as instrumental variables in equation (iv), and could in some cases also have a direct influence in market outcomes. Using this specification, one can test for example whether regulatory independence is necessary or redundant (and hence socially too expensive) once the country has other ways to enforce contracts and credibly commit to stable policies. Levy and Spiller (1996) and Henisz and Zelner (2000b) argue that the creation of independent agencies is one among several options available to countries that want to commit credibly not to expropriate the sunk investments that characterize network industries. Whether this option will be exercised or not depends on the institutional endowment and the structure of interest groups.

Hypothesis 2)The setting up of truly independent regulatory agencies is a policy decision itself, which depends on the institutional endowment of each country and the interest of dominant interest groups in the outcomes of this institutional setting relative to the alternatives.

There is a general consensus that competition in the non-natural monopoly segments of telecommunications is both possible and beneficial for social welfare, especially through improvements in incentives and productivity. Some scholars think, however, that there is a thin line that should not be crossed between promoting competition and protecting particular competitors that may not be as efficient as the incumbent firms. In addition to this argument, these scholars also warn against the danger of expropriating dominant operators' sunk investments in infrastructures.[6] Other scholars emphasize the

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[6] See Sidak and Spulber (1997).

potential for strategic delegation into relatively pro-industry regulators, in an analogy with strategic Rogoff delegation into conservative central bankers in monetary policy (Levine et al., 2002). Pro-industry regulators (or regulators who have a duty to behave in a "pro-industry" way) would not expropriate sunk investments.

Hypothesis 3)Market-opening policies (although not necessarily asymmetric regulation) have a positive effect on productivity and independent agencies have a positive effect on investment.

3.Data

3.1.Policy Data

One of the main contributions of this study is to present four new indices of telecommunications sector policies (the values of these indices for the 37 countries in our sample are reported in the appendix). The four indices are based on information collected for 37 countries (both developed and developing) about their policies in 1998. Data have been collected from web pages, legislative texts published by the different regulatory authorities, documents and working papers of the OECD and the International Telecommunications Union (ITU), studies carried on behalf of the European Commission, and articles from specialized journals.

The two indices on entry policies (*entry* and *trada21998*) aggregate information on the following issues:

-The degree to which entry in the industry is subject to investment conditions of any kind.

-The average of the number of mobile providers in 1996 and 1997.

-The method of spectrum allocation.

-The existence of number portability in fixed and mobile telephony.

-The existence of carrier selection and carrier pre-selection in local, long distance and international telephony.

-The rules governing mobile to mobile, and fixed to mobile, interconnection rates.

-The availability of local loop unbundling and rules governing the access to alternative infrastructure.

We have associated a metric to each of these variables, with the lowest value for policies that are less favourable to easiness of entry and a higher value to policies that are more favourable. These values have been aggregated into two indices, namely *entry* and *trada21998*. The difference between *entry* and *trada21998* is that whereas the former is an *ad hoc* index that just adds up the values in all the "entry" dimensions that have been considered, the latter is chosen among four new variables that summarize all the observations in these dimensions using principal components analysis. The new variable reflects mostly the introduction of number portability in fixed telephony, the absence of investment conditions for entrants, the presence of long-distance and international carrier pre-selection, and the introduction of local loop unbundling. For this reason, we think that this new variable describes well the degree to which regulation is asymmetrically biased in favour of entrants.

Of the 37 countries for which we collected information, 33 had a separate regulatory agency in operation in 1998 (all except Chile, Japan, New Zealand and Israel). Of these, 18 had set up the regulatory agency prior to 1997. In this year, as many as 11 agencies started operating, and four of them started in 1998. The oldest agency is the FCC of the US, which started operating in 1934, and the next one at the national level was not created until 1976 in Canada. All the others were created in the 1990s. Therefore, the establishment of separate regulatory agencies is a very recent phenomenon. The two indices on regulator independence (*indep* and *nra1*) are based on information which covers the following issues:

-The degree to which the regulatory agency is competent in the following policies: licensing, interconnection, tariffs, scarce resources allocation (such as spectrum frequencies and numeration plans), and universal service.

-The degree to which its funding sources are independent of the government's discretion.

-The rules of appointment of the head of the agency or its board.

-The length of the term in office for the head of the office or the members of the board.

-The rules about obligations to report to the government, parliament or another official body.

-The years since the establishment of the agency's effective operation.

-The percentage of public ownership of the incumbent.

We have associated a metric to each of these variables, with the lowest value for policies that give less independence to the office and a higher value to policies that give more independence. These values have been aggregated in two indices, *indep* and *nra1*. The difference between *indep* and *nra1* is that whereas the former is an *ad hoc* index that just adds up the values in all the "independence" dimensions that have been considered, the latter is chosen out of the three new variables that summarize all the observations in these dimensions using principal components analysis. This new variable reflects mostly the regulator's capacity of setting tariffs and interconnection charges and, to a lesser extent, its independence of the government in terms of funding and length of term in office.

3.2. Performance data

Data on telecommunications sector performance is obtained from the International Telecommunications Union (ITU) database. We focus on performance data on network penetration and productivity data.

Network penetration is described as main lines per 100 inhabitants. We focus on the level of this variable in 1998 (*lines10098*) and 2001 (*lines10001*), the last year available, and its growth (*linesgrowth*) since 1998, the year for which we computed the policy measures.

Productivity is measured as subscribers per employee and main lines per employee. For both we use the levels in 2000 (*subworker00* and *linesworker00*), the last year available, and the growth in the variable subscribers per worker variable between 1998 and 2000 (*grsubwo*).

3.3. Political and institutional data

We have collected a number of political variables on the general quality of government, interest groups, ideology, institutions and tradition relative to the state's involvement in the economy.

Our ideological variable *iddummy* has a value of one if the largest party in the government was a right wing party as of January, 1st 1997, and a value of zero if the largest party has any other orientation. We elaborated this variable from the original Beck et al.'s (2001) data set.[7]

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[7] The original data set on ideologies by Beck et al. labels the largest party in each country's government as left, center, right or non-applicable. However, the way they allocate the left or center label to different

We have two variables reflecting the interventionist tradition of each country, i.e., the degree to which the state has an inclination to intervene in economic matters. Both of them are collected from LaPorta's web page at the Economics Department of Harvard University. One of them, *legal*, reports whether the legal origin of the country belongs to English Civil Law or to other more interventionist traditions, such as socialist, French Common Law, German Common Law or Scandinavian Common Law. LaPorta et al. (1999) argue that this proxies for the degree of interventionism of the state in economic matters, since English Civil Law was set up to protect the owners from the sovereign, whereas traditions such as the French Common Law were designed to reinforce the role of the state. The socialist tradition would be an extreme case of interventionism and the other two would be intermediate cases between English and French. We give a value of 0 to 4 in the order of more interventionist to less (so the order is socialist, French, German, Scandinavian, English). Moreover, this variable is interesting as a potential instrument because it is exogenous and uncorrelated with performance in telecommunications, since the legal origin is usually associated to colonization or conquest. The other measure of interventionism, *procedures*, is the number of steps that a new business has to take in order to start operating, and it is obtained from LaPorta et al. (2002).

We have some variables reflecting the weight of some interest groups in the policies of interest, although clearly this is an area that can be expanded in future research. We have the number of telecommunications workers divided by the overall population in 1992 and 1994 (*staff92 and staff 94*) as a measure of the size of the incumbent, and the percentage of urban population (*urbanpop94*) as a measure of the size of a social group demanding new services and hence *a priori* in favour of telecom liberalization.

We have three variables reflecting the general quality of government, obtained from Kaufmann and Kraay (2002). This are *regqual*, *goveff* and *rulelaw*, and they are composite indices measuring, respectively, the general quality of government, government effectiveness and the rule of law.

And we have one additional variable, *xconst45_98*, which is an index of institutional constraints on executive bodies, first used in Henisz and Zelner (2000). We use the average for this index between 1945 and 1975. This index gives a measure of the ability

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largest parties seemed to us somehow inaccurate. For example, they attach the label left both to the Cuban and to the Clinton government in the US, whereas the Prodi administration in Italy and the center-left

of governments to commit themselves or their successors to policies not to expropriate investments.

Table 1 reports the correlation matrix of these institutional and political variables for our observations, plus our two indices of regulator independence, *indep* and *nra1*. The table clearly shows that these variables are measuring different phenomena, and that not taking some of them into account may lead us to omit some important influences in the analysis. The rule of law index, the government effectiveness index and the regulatory quality index are highly positively correlated. The legal origin and the number of procedures to set up a new business are highly negatively correlated. Surprisingly, our two indices of regulatory independence are not highly correlated with any of the other institutional indices. We tackle this issue more in depth below, when we discuss our preliminary results.

Table 1

	regqual	indep	nra1	goveff	rulelaw	legal	xconst45_98	procedures
regqual	1							
indep	0.1078	1						
nra1	0.0493	0.7080	1					
goveff	0.9221	0.1246	0.0093	1				
rulelaw	0.8743	-0.009	-0.087	0.9285	1			
legal	0.4439	-0.013	-0.275	0.4823	0.4963	1		
xconst45_98	0.3558	-0.027	-0.161	0.4971	0.5447	0.6194	1	
procedures	-0.639	-0.028	0.0845	-0.648	-0.664	-0.775	-0.6393	1

We also have data on the GDP per capita in 1998 in dollar terms to control for the level of development in each country, which may also influence telecom performance.

There is a high correlation between regulatory quality (and also government effectiveness and rule of law) and GDP per capita. The following graph points to a non-linear positive association between both:

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ruling coalition in Chile are allocated the Center label. The way they allocate the right label seemed to us more clear cut.
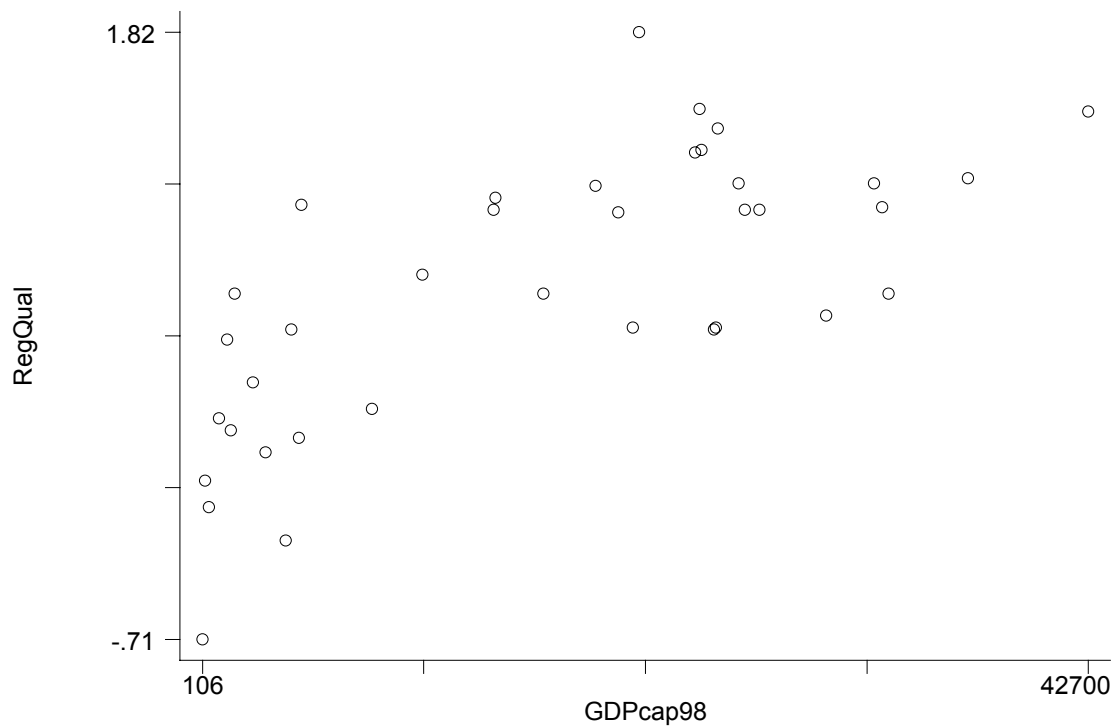
4. Preliminary Results

4.1. The determinants of endogenous policies

Tables 2a-d show that legal origins and lagged performance are significant determinants of the entry index. Our estimations are consistent with the hypothesis that less interventionist societies tend to liberalize more, although they do not necessarily tend to impose more regulatory asymmetry. Societies with better telecommunications sectors also tend to liberalize more. Interestingly, the principal components index of asymmetric deregulation, *trada21998*, however, did not show any significant pattern.

Table 2a

	OLS estimates	t-statistic
Dependent Variable	**entry**	
Intercept	-.6412943	-0.74
legal	.4984411	2.97
iddummy	-.1707091	-0.34
urbanpop94	.015199	0.95
subsworker94	.0058445	1.39
# Observations	37	
R-Squared	0.3965	

Table 2b

	OLS estimates	t-statistic
Dependent Variable	**entry**	
Intercept	-.0718073	-0.12
legal	.5015454	3.04
subsworker94	.0085311	2.85
# Observations	37	
R-Squared	0.3793	

Table 2c

	OLS estimates	t-statistic
Dependent Variable	**entry**	
Intercept	-.0558621	-0.09
legal	.5419218	3.27
linesworker94	.0086778	2.61
# Observations	37	
R-Squared	0.3599	

Table 2d

	OLS estimates	t-statistic
Dependent Variable	**entry**	
Intercept		
procedures	-.1394231	-2.60
linesworker94	.0085237	2.24
# Observations	37	
R-Squared	0.3449	

Ideology, however, appears to have no impact on the decision to liberalize, as shown in Table 3. Telecommunications liberalization does not appear to be a partisan policy. This is not incompatible with some aspects of the reform process being partisan. For example, privatization of the incumbent could be a partisan policy, with right wing parties more inclined to privatize. But our composite indices do not distinguish between individual dimensions, and hence we are not able to make any inference on them.

Table 3

	OLS estimates	t-statistic
Dependent Variable	**entry**	
Intercept	-.0503046	-0.08
legal	.542201	3.22
iddummy	-.0680929	-0.14
linesworker94	.0087813	2.54
# Observations	37	
R-Squared	0.3603	

As we saw in Table 1, our two indices of regulatory independence are not highly correlated with any of the other institutional indices, and in particular they are not correlated with overall regulatory quality. We interpret this as evidence that formal regulatory independence is compatible with different levels of general regulatory or institutional quality. However, this does not mean that regulator independence does not show any systematic pattern. Our regression results on the determinants of independence (see tables 4a-b) show that independence is a substitute for other ways to achieve commitment not to expropriate. In particular, the index of constraints on the executive appears to be negatively and significantly related to the creation of truly independent regulatory agencies. The sign of the ideological dummy and of the rule of law variable are also negative although not significant. This is consistent with the Levy and Spiller (1996) view of regulatory commitment and credibility. Countries achieve regulatory commitment not to expropriate investment, yielding good results in terms of industry performance, if they are able to create credible institutions that are well adapted to the institutional endowment of each country. Since institutional endowments vary across countries, the way different countries set up commitment institutions will vary. Take the cases of the UK and Chile, two countries that were among the first to successfully privatize their telecommunications incumbents and introduce competition. The UK, with its centralized system and majoritarian government has very few constraints on the executive's behaviour, so that new and special institutions, such as an independent regulator, must be put in place to achieve commitment.

Table 4a

	OLSestimates	t-statistic
Dependent Variable	**Nra1**	
Intercept	.5915471	1.11
iddummy	-.3931289	-1.18
staff94	6.003888	2.65
rulelaw	-.4127745	-1.52
xconst45_98	-.233859	-2.00
# Observations	37	
R-Squared	0.2547	

Table 4b

|	OLSestimates	t-statistic
Dependent Variable	**indep**	
Intercept	5.895357	4.52
iddummy	-1.139659	-1.40
staff94	15.28706	2.75
rulelaw	-1.0595	-1.59
xconst45_98	-.3805054	-1.33
# Observations	37	
R-Squared	0.2545	

In addition to this, the way the independent regulator is set up takes advantage of other features of the British institutional endowment, such as the respect for contracts and the independence of the judiciary. In Chile, however, with a presidential system and coalition governments, it is very difficult to change legislation, so that commitment is achieved through very detailed legislation, which, as thought at the time of reform, would make setting up a regulatory agency redundant and hence not cost effective if there is any cost to independence (for example in terms of political legitimacy or other costs to the political principals). Hence Chile is one of the few countries in our data set that does not even have a separate telecom regulator.

Quite robustly in our regressions, the effect of the size of the incumbent (as measured by the number of telecommunications staff some years before the reform, namely in 1994 and 1992) has a positive and statistically significant effect on the decision to create a truly independent regulatory agency. This is a surprising result, and we interpret it as the incumbent preferring an independent regulator in the face of the coming liberalization, which will inevitably be associated with more interest group competition. This is consistent with the view of Henisz and Zelner (2000) on the electricity industry, where they show that incumbents lobby for the creation of constraints on investment expropriation if they foresee strong interest group competition.

4.2 The effects of policies

We first investigate the determinants of telecommunications network penetration (lines per 100 inhabitants and growth in lines per 100 inhabitants). These are the endogenous variables usually focused on in the studies that work with the ITU data set.

The following graph suggests the existence of a positive association between entry policies and telecom penetration:
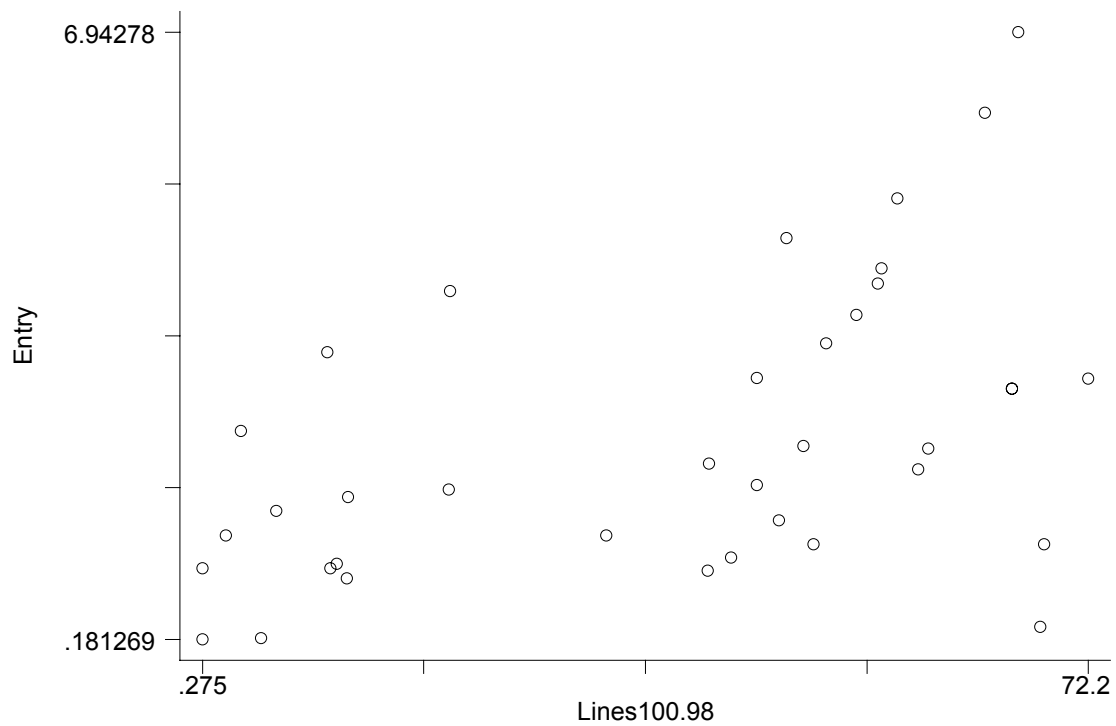
In the regressions results, although the entry index is not significantly related to growth in network penetration, it is significantly related to network penetration in 2001(see tables 5a-b) if liberalization is taken as exogenous. This significant relationship disappears once the endogeneity of liberalization is taken into account.

Table 5a

	OLS estimates	t-statistic
Dependent Variable	lines10001	
Intercept	6.223462	2.37
gdpcap98	.001765	15.33
entry	2.173517	2.47
# Observations	37	
R-Squared	0.9012	

Table 5b

	IV estimates	t-statistic
Dependent Variable	lines10001	
Intercept	6.813583	1.63
gdpcap98	.001781	11.92
entry	1.824838	0.84
# Observations	37	
R-Squared	0.9002	

Instrumented:*Entry*/Instrument:*legal*.

The *entry* shows the same pattern in determining the telecom network penetration, as reported in Tables 6a-b, if we control for the effect of institutional variables such as regulatory quality.

Table 6a

	OLS estimates	t-statistic
Dependent Variable	lines10001	
Intercept	5.893217	2.26
gdpcap98	.0016269	10.86
entry	1.725991	1.87
regqual	4.910904	1.41
# Observations	37	
R-Squared	0.9068	

Table 6b	IV estimates	t-statistic
Dependent Variable	lines10001	
Intercept	6.993702	1.65
gdpcap98	.0016312	10.69
regqual	5.925041	1.26
entry	.9316063	0.36
# Observations	37	
R-Squared	0.9042	

Instrumented*: entry*

Instruments:*legal*

Hence OLS over-estimates the contribution of the entry variable.

The independence of the regulator does not appear to be a significant determinant of network penetration with OLS, but it becomes significant at the 10% level when we take into account the endogeneity of independence through Instrumental Variable estimation, as shown in Tables 7a-d.

Table 7a

	OLS estimates	t-statistic
Dependent Variable	lines10001	
Intercept	8.285623	2.13
gdpcap98	.0018636	16.00
indep	.2909294	0.49
# Observations	37	
R-Squared	0.8843	

Table 7b

	OLS estimates	t-statistic
Dependent Variable	lines10001	
Intercept	9.937633	4.16
gdpcap98	.0018595	15.93
nra1	.8972316	0.541
# Observations	37	
R-Squared	0.8848	

Table 7c

	IV estimates	t-statistic
Dependent Variable	**lines10001**	
Intercept	-15.82578	-0.99
gdpcap98	.0017327	7.06
indep	5.169759	1.67
# Observations	37	
R-Squared	0.6096	

Instrumented: *indep*
Instruments: *staff94, xconst45_98*

Table 7d

	IV estimates	t-statistic
Dependent Variable	**lines10001**	
Intercept	10.61103	3.17
gdpcap98	.0018608	11.01
nra1	8.359294	1.72
# Observations	37	
R-Squared	0.7820	

Instrumented:*nra1*/Instruments:*staff94,xconst45_98*

Next, we look at the determinants of productivity in the telecommunications sector, as measured by subscribers per employee and lines per employee. The principal components index of asymmetric deregulation has a negative impact on productivity (measured as subscribers per employee) in levels, although the significance of this estimate declines as we add variables. The same happens when productivity is measured as lines per employee, although the regression results are not reported here.

Table 8

	OLS estimates	t-statistic
Dependent Variable	**subsworker00**	
Intercept	311.5764	4.72
gdpcap98	.0014085	0.33
trada21998	-80.46346	-2.05
regqual	133.5519	1.39
# Observations	37	
R-Squared	0.1862	

We checked for the effect of the ad hoc *entry* index on productivity, first with OLS and next with IV estimation using the legal index as instrumental variable, without any significant results.

Finally, we see in Tables 9a-c that regulator independence has a negative or non significant (when appropriately instrumented) effect on productivity.

Table 9a

	OLS estimates	t-statistic
Dependent Variable	**linesworker00**	
Intercept	218.8331	4.69
gdpcap98	.0026235	1.85
indep	-13.5829	-2.00
entry	7.860585	0.72
# Observations	37	
R-Squared	0.2087	

Table 9b

	OLS estimates	t-statistic
Dependent Variable	**subsworker00**	
Intercept	472.6807	4.28
gdpcap98	.0050013	1.49
indep	-24.21684	-1.51
entry	4.929714	0.19
# Observations	37	
R-Squared	0.1238	

Table 9a

	IV estimates	t-statistic
Dependent Variable	**linesworker00**	
Intercept	342.9504	2.23
gdpcap98	.005167	2.19
indep	-21.675	-0.75
entry	-42.40925	-1.25
# Observations	37	
R-Squared		

Table 9b

	IV estimates	t-statistic
Dependent Variable	**subsworker00**	
Intercept	774.7448	2.25
gdpcap98	.010074	1.90
indep	-52.31917	-0.80
entry	-90.9437	-1.19
# Observations	37	
R-Squared		

Instrumented: *entry, indep*

Instruments: *legal, staff94*

Instrumented: *entry, indep*/Instruments:*legal, staff94*

5. Conclusions

In this paper, we presented new data, in the form of four indices, on entry policies and the independence of regulators for a cross section of countries. These indices were combined with a comprehensive set of performance, institutional and political data to quantify both the determinants and the impact of telecommunications policies. We found that entry policies are associated with the degree to which countries have an interventionist tradition, but not with the partisan ideology of reforming countries per se. We also found that countries where the institutional endowment constrains less the behaviour of the executive bodies, and countries with a stronger incumbent, are more prone to create truly independent regulatory agencies. There is weak evidence that the creation of truly independent regulatory agencies has a positive effect on network penetration, as estimated taking into account the endogeneity of independence. There is still no evidence, with this small data set, of a significant effect of market opening

policies (a positive significant effect on network penetration would be predicted with the same data set if the endogeneity of market opening policies was not taken into account).

Despite the importance of creating politically sustainable regulatory systems, the establishment of separate regulatory agencies in telecommunications is a very recent phenomenon.

Equivalently, it is probably too early to reach any final conclusion on the effects of different liberalization policies. Although at this stage of our research project we have reached some provisional conclusions that complement those of the existing literature, more observations will be needed to make progress in the overall assessment.

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Appendix: data on liberalization and regulator independence

	nra1	indep	entry	trada21998
Germany	0,19029	7,67095	5,09184	3,03192
Chile	-2,01649	1	4,059	0,15638
France	-0,66522	4,20381	2,07237	-0,48506
USA	0,0352	9,38095	6,94278	0,853
Spain	0,59838	5,84762	2,13408	-0,59481
Italy	0,3653	5,85	1,89987	-0,92657
Japan	-2,01649	0,35	3,79233	-0,42421
N. Zealand	-2,01649	1	4,64653	-0,98545
UK	1,311	6,51429	4,31309	1,56787
Sweden	0,93042	6,25714	3,08131	-0,41989
Perú	0,70353	4,40476	1,60863	-0,67873
Argentina	-0,7008	4,24762	1,84994	-0,59886
Canada	0,72516	9,31429	6,04781	1,30539
Mexico	0,27196	3,75143	3,37677	0,74609
Venezuela	0,19817	7,5381	1,02202	-0,45261
Brazil	0,62186	7,84762	1,76561	-0,03961
India	-1,5399	0,5619	1,33618	0,19229
Philippines	-0,2334	7,4381	2,5	-0,05405
Singapore	0,62973	7,08143	3,08843	-0,15796
Israel	-2,01649	0,46	1,50674	0,09664
Jordan	0,27204	7,8381	0,97128	-0,48573
Morocco	0,24166	3,78095	0,19388	-0,32733
Ethiopia	-0,59084	5,57088	0,18127	-0,24681
Madagascar	0,62199	6,62776	0,97473	-0,45348
South Africa	-0,39637	7,31429	0,85994	-0,44678
Bulgaria	1,62873	5,06667	1,33426	-0,24087
Finland	0,23449	4,4501	4,14624	3,63491
Denmark	0,71002	8,0381	2,97274	-1,1273
Norway	0,81038	6,30476	2,96901	-0,96191
Portugal	0,47087	7,77857	0,94137	-0,54706
Switzerland	-0,52012	5,47143	1,23732	-0,05314
Australia	-1,72753	4,17762	3,47705	0,46473
Austria	0,87485	5,51429	2,33373	-0,03961
Belgium	0,41756	5,68048	1,23472	-0,49076
Ireland	-0,37116	7,33333	1,08901	-0,42951
Luxembourg	0,97623	3,5619	0,32099	-0,48045
Netherlands	0,9715	6,26676	2,30331	0,09933